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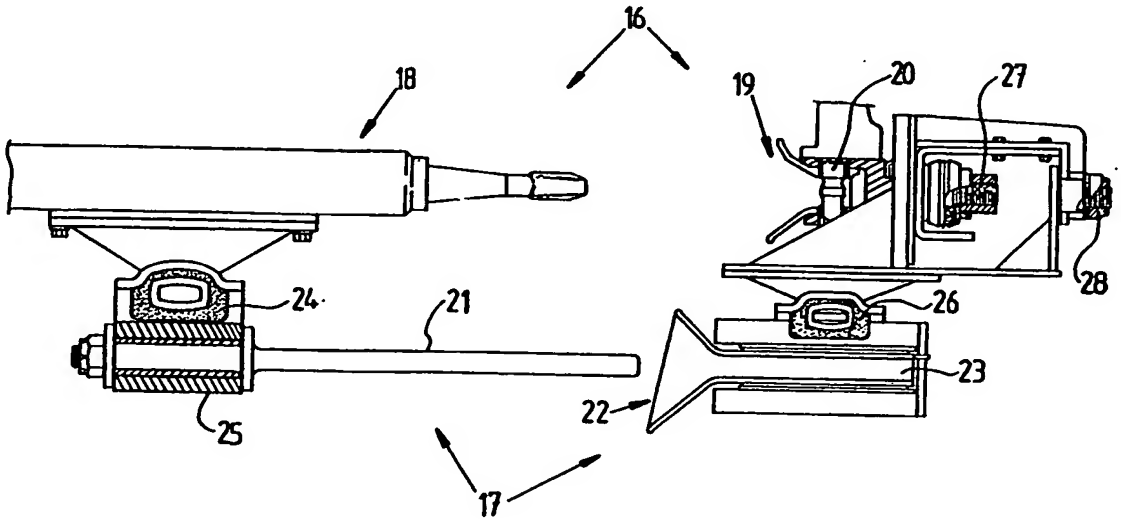

(57) Abstract

A sway stabilisation system to inhibit an undesirable sideways sway between a towed vehicle (15) and a lead vehicle (14) comprises a brake assembly (17) including brake means disposed between the vehicles, sway detection means responsive to undesirable sway and a brake means controller responsive to detection of undesirable sway by the sway detection means to initiate operation of the brake means, the brake means being operable to inhibit undesirable sway while the vehicles are travelling. The brake assembly (17) has respective towed vehicle parts (21) and lead vehicle parts (22) operatively coupled together in parallel with the draw bar and hitch assembly (16) coupling the lead vehicle (14) and the towed vehicle (15).

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"SWAY STABILISATION SYSTEM"

TECHNICAL FIELD OF THE INVENTION

THIS INVENTION relates to a sway stabilisation system for a towed vehicle drawn behind a lead vehicle and in particular but not limited to a sway stabilisation system for an articulated vehicle of the type having a prime mover coupled to a first trailer via a fifth wheel coupling and one or more towed trailers behind the first trailer.

BACKGROUND ART

Undesirable sway between a towed vehicle and a lead vehicle can lead to the towed vehicle moving out of control and causing an accident. One typical accident is known as a "jack-knife" where the towed vehicle swivels out of control relative to the lead vehicle possibly shearing its coupling to the lead vehicle and rolling or causing the lead vehicle to roll as well.

Undesirable sway can cause accidents when a vehicle is turning, when a vehicle is braking or during collision, and it would be desirable to provide a system to stabilise sway and thereby inhibit undesirable sway during these situations.

OUTLINE OF THE INVENTION

With the foregoing of other objects in mind, the present invention resides in one aspect in a sway stabilisation system to inhibit an undesirable side-ways sway between a towed vehicle and a lead vehicle, the system having a brake assembly including brake means disposed between the vehicles, sway detection means responsive to undesirable sway and a brake means controller responsive to detection of undesirable sway by the sway detection means to initiate operation of the brake means, the brake means being operable to inhibit undesirable sway and the brake means controller being adapted to automatically actuate the brake means in response to detected undesirable sway while the vehicles are travelling.

The towed vehicle and lead vehicle are typically coupled together using a hitch pin and draw bar assembly,

the brake assembly comprising a hitch pin and draw bar follower means having opposed ends coupled to the towed vehicle and lead vehicle respectively in order to follow the hitch pin and draw bar assembly as the vehicles travel. One end of the hitch pin and draw bar follower means typically includes a sway transmission member protruding from the towed vehicle in parallel with the draw bar and extending toward the lead vehicle, and the opposed end of the hitch pin and draw bar follower means having a hollow rotatable braking surface carrier means secured to the lead vehicle and being adapted to receive the sway transmission member and rotate therewith in response to movement of the draw bar relative to the hitch.

The sway transmission member and/or the braking surface carrier means, are preferably flexibly mounted or otherwise moveably secured to the respective vehicles to allow limited torsional movement as the vehicles travel so as not to interfere with the normal operation of the hitch pin and the draw bar assembly.

The brake means typically comprises a horizontal braking surface coupled or otherwise secured to the rotatable braking surface carrier means and a controllably movable non-rotatable braking surface adapted to engage the rotatable braking surface in response to the controller initiating braking in order to automatically resist the pivotal movement of the draw bar relative to the hitch, thereby providing a braking action against undesirable sway.

The non-rotatable braking surface is preferably driven into braking contact with the rotatable braking surface using a drive means operating under influence of the brake means controller in response to undesirable sway being detected by the sway detection means disposed on the vehicle. The sway detection means preferably employs one or more sensor means, the sensor means typically includes one or a plurality of sensors operating independently or in conjunction with one another, the sensors being selected

from the following:-

(i) a coupling transducer adapted to monitor angular position of the towed vehicle relative to the lead vehicle;

(ii) a steering transducer adapted to monitor vehicle steering;

(iii) a collision transducer adapted to sense a collision condition; and/or

(iv) a footbrake transducer adapted to monitor operation of a footbrake operated by a driver of the vehicles.

In one typical controller, the transducers supply data to a cab decision circuit with the steering transducer, collision transducer and footbrake transducer being located on a cab of a prime mover, the cab decision circuit operating in conjunction with the data supplied from the transducers to actuate the brake means to inhibit undesirable sway. Typically, an independent trailer decision circuit is employed which responds to undesirable sway being detected by the coupling transducer where say, oscillation of the towed vehicle away from a predetermined position occurs more than once within a predetermined time period, then the brake means is applied for a short period of time, the application of the brake means being made when the coupling transducer detects the trailer oscillation passing through or adjacent the predetermined position. For example, application of the brake means would occur for say a seven second application and then be released. This would occur automatically under this type of control.

In the case of a collision or sudden braking action by the vehicle driver, the collision transducer would detect this and the controller would automatically apply the brake means for say five seconds.

The controller would continually monitor the steering transducer to determine whether the trailer is in a normal position according to any turning action being imposed on the vehicles by normal steering. This would be taken into account before application of the brake means. The brake

means can operate whenever the footbrake is applied or alternatively can operate only in response to undesirable sway. Preferably a manual over-ride switch is employed so that the brake means can be turned off and by-passed or turned on as an aid to reversing the vehicles.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the present invention can be more readily understood and be put into practical effect, reference will now be made to the accompanying drawings which illustrate preferred embodiments of the invention and wherein:-

Figure 1 is a schematic side view illustrating vehicles employing a sway stabilisation system according to the present invention;

Figure 2 is a part sectional view illustrating a preferred brake assembly suitable for use in a sway stabilisation system according to the present invention and showing the parts of the assembly separated;

Figure 3 is a view similar to that of Figure 2 but with the parts of the assembly operatively coupled together;

Figure 4 is a plan view illustrating the parts operatively coupled together;

Figure 5 is a schematic circuit diagram illustrating part of a brake means controller suitable for a sway stabilisation system according to the present invention; and

Figure 6 is a block diagram illustrating operation of a typical electrical circuit portion of a second embodiment of a brake means controller suitable for a sway stabilisation system according to the present invention.

METHOD OF PERFORMANCE

Referring to the drawings and initially to Figure 1, there is illustrated a vehicle in the form of a road train 10 having a prime mover 11, a first trailer 12 articulated to the prime mover 11 via a fifth wheel coupling 13, and second and third trailers 14 and 15. The trailer 14

comprises a lead vehicle while the trailer 15 comprises a towed vehicle, the lead vehicle and towed vehicle being coupled together using a draw bar and hitch assembly shown generally at 16. Undesirable sway between the lead vehicle 14 and towed vehicle 15 is stabilised using a sway stabilisation system according to the present invention. The sway stabilisation system employs a brake assembly shown generally at 17, the brake assembly having respective towed vehicle parts and lead vehicle parts operatively coupled together in parallel with the draw bar and hitch assembly 16.

Referring now to Figure 2, there is illustrated the draw bar and hitch assembly 16 and the brake assembly 17 prior to the lead vehicle and towed vehicle being coupled together. The draw bar and hitch assembly 16 includes a draw bar 18 and a hitch 19 employing a hitch pin 20 so that the draw bar 18 can pivot in a generally side-ways direction and also move up and down according to steering and road undulations respectively.

The brake assembly 17 includes a towed vehicle part in the form of a sway transmission member comprising a flattened bar 21 protruding toward the lead vehicle and secured to the draw bar 18 generally parallel thereto. The bar 21 is aligned with co-operating lead vehicle part in the form of a braking surface carrier means 22 having a elongate recess 23 adapted to automatically take the bar 21 and hold it captive by virtue of the draw bar 18 being coupled to the hitch 19. The bar 21 is coupled to the draw bar via a rubber mount at 24, the bar 21 having a fixed end secured in rubber bushing at 25 so that the bar 21 is capable of limited torsional movement away from its parallel position in relation to the draw bar 18. Similarly the braking surface carrier means 22 is mounted to the lead vehicle via a rubber mounting 26 so that it too can tolerate torsion. The hitch 19 and braking surface carrier means are adapted to rotate on stubs 27 and 28 in response to relative movement between the vehicles.

Referring now to Figure 3, the hitch and draw bar assembly 16 and the brake assembly 17 are shown coupled together and where appropriate like numerals have been used to illustrate like features. The braking surface carrier means 22 includes a lead-in guide 29 for the bar 21 and a circular portion 30 which carries on upper and lower surfaces thereof respective braking pads 31 and 32. The pads are secured to the surfaces or integrally formed therewith. The braking pads rotate with the braking surface carrier means 22 in response to movement of the bar 21. Respective clutch plates 33 and 34, are disposed as non-rotatable braking surfaces adjacent the respective brake pads 31 and 32 and are moveable by operation of drive means in the form of eight pneumatic pistons located four top and four bottom and shown at 35.

A brake means controller is employed to activate the pneumatic pistons to apply the clutch plates 33 and 34 to the brake pads 31 and 32 whenever undesirable sway is detected by sensors (to be described below) in order to inhibit undesirable sway.

One of these sensors is a coupling transducer depicted in Figure 4 in the form of a proximity switch 36 which monitors steady angular motion of the towed vehicle relative to the lead vehicle. The proximity switch operates in conjunction with a decision circuit to be described below and takes account of abnormal relative motion to initiate braking via the controller.

Referring now to Figure 5, a typical controller 37 is illustrated including an electrical circuit portion and a pneumatic circuit portion, the electrical circuit portion includes a decision making circuit 38 and a plurality of sensors including a steering wheel position transducer 39, a footbrake position transducer 40, a collision transducer 41 including an inertial sensor 42 and manual switches 43 and 44. The manual switch 43 is operable to inhibit operation of solenoid valve 45 in order to by-pass operation of the brake means. The manual switch 44

includes a pneumatic valve as well as an electrical switch so that the pneumatic pistons 35 can receive compressed air along line 46 so that the brake means can be applied while a driver is reversing the vehicles. In this embodiment an input lead 47 from the controller is coupled to the proximity sensor 36 (see Figure 4). Compressed air for operation of the pneumatic pistons 35 is held ready in a storage tank 48 having been previously generated in a compressor communicating with the tank 48 via compressed air line 49. The tank 48 is mounted adjacent the brake means on the rear of the lead vehicle 14.

The decision making circuit 38 monitors the position of the steering wheel sensor 39 and thereby deduces normal appropriate positions of the towed vehicle relative to the lead vehicle. Departures from normal operation are detected by the other sensors to initiate braking via the controller. Operation of the footbrake 40 can initiate operation of the pneumatic pistons 35 while on other occasions, operation of the pneumatic pistons is via solenoid valves 45 and 50 via the controller.

The duration of application of braking force via the pneumatic pistons 35 is usually for short time periods only, the time periods being of the order of five to seven seconds. In the case of the footbrake, the duration of braking is for the duration of manual braking applying the vehicle's standard braking system.

An alternative electrical circuit as illustrated in Figure 6 and where this circuit employs the same transducers as in previous Figure 5, appropriate like numerals have been used to illustrate like features. The decision making circuit in this case has been divided into two circuit elements being a cab decision circuit 51 and a trailer decision circuit 52, both decision circuits having extra inputs 53 and 54, it being appreciated that automatic operation of the brake means can be initiated by particular conditions being sensed by the coupling transducer 36 quite apart from the other sensors. In this case, braking is

initiated at the trailer without any need for data from the other transducers. This typically occurs where there are repeated detections of the trailer moving outside normal conditions in an oscillatory fashion within say a five second interval. This condition is indicative of undesirable sway thereby immediately initiating operation of the brake means for say a five second period via the trailer decision circuit.

As the brake means operates independently of the vehicle's standard braking system there is no possibility of the sway stabilisation system interfering with normal braking.

Whilst the above has been given by way of illustrative example of the present invention, many variations and modifications thereto will be apparent to those skilled in the art without departing from the broad ambit and scope of the invention as set forth in the appended claims.

CLAIMS

1. A sway stabilisation system to inhibit an undesirable side-ways sway between a towed vehicle and a lead vehicle, the system having a brake assembly including brake means disposed between the vehicles, sway detection means responsive to undesirable sway and a brake means controller responsive to detection of undesirable sway by the sway detection means to initiate operation of the brake means, the brake means being operable to inhibit undesirable sway and the brake means controller being adapted to automatically actuate the brake means in response to detected undesirable sway while the vehicles are travelling.

2. The system of claim 1 wherein the towed vehicle and lead vehicle are coupled together using a hitch pin and draw bar assembly, the brake assembly comprising a hitch pin and draw bar follower means having opposed ends coupled to the towed vehicle and lead vehicle respectively in order to follow the hitch pin and draw bar assembly as the vehicles travel, one end of the hitch pin and draw bar follower means including a sway transmission member protruding from the towed vehicle in parallel with the draw bar and extending toward the lead vehicle, and the opposed end of the hitch pin and draw bar follower means having a hollow rotatable braking surface carrier means secured to the lead vehicle and being adapted to receive the sway transmission member and rotate therewith in response to movement of the draw bar relative to the hitch.

3. The system according to claim 2 wherein the sway transmission member and/or the braking surface carrier means are preferably flexibly mounted or otherwise moveably secured to the respective vehicles to allow limited torsional movement as the vehicles travel so as not to interfere with the normal operation of the hitch pin and the draw bar assembly.

4. The system according to claim 2 wherein the brake means comprises a horizontal braking surface coupled or

otherwise secured to the rotatable braking surface carrier means and a controllably movable non-rotatable braking surface adapted to engage the rotatable braking surface in response to the controller initiating braking in order to automatically resist the pivotal movement of the draw bar relative to the hitch, thereby providing a braking action against undesirable sway.

5. The system according to claim 4 wherein the non-rotatable braking surface is preferably driven into braking contact with the rotatable braking surface using a drive means operating under influence of the brake means controller in response to undesirable sway being detected by the sway detection means.

6. The system according to claim 1 wherein the sway detection means employs one or more sensor means, the sensor means includes one or a plurality of sensors operating independently or in conjunction with one another, the sensors being selected from the following:-

(i) a coupling transducer adapted to monitor angular position of the towed vehicle relative to the lead vehicle;

(ii) a steering transducer adapted to monitor vehicle steering;

(iii) a collision transducer adapted to sense a collision condition; and/or

(iv) a footbrake transducer adapted to monitor operation of a footbrake operated by a driver of the vehicles.

7. The system according to claim 6 wherein the transducers supply data to a cab decision circuit with the steering transducer, collision transducer and footbrake transducer located on a cab of a prime mover, the cab decision circuit operating in conjunction with the data supplied from the transducers to acuate the brake means to inhibit undesirable sway, the system further comprising an independent trailer decision circuit which responds to undesirable sway being detected by the coupling transducer where oscillation of the towed vehicle away from a

predetermined position occurs more than once within a predetermined time period, then the brake means is applied for a short period of time, the application of the brake means being made when the coupling transducer detects the trailer oscillation passing through or adjacent the predetermined position.

8. The system according to claim 1 wherein the vehicles include a braking system actuated by a footbrake, the braking and the sway stabilisation system being independent systems.

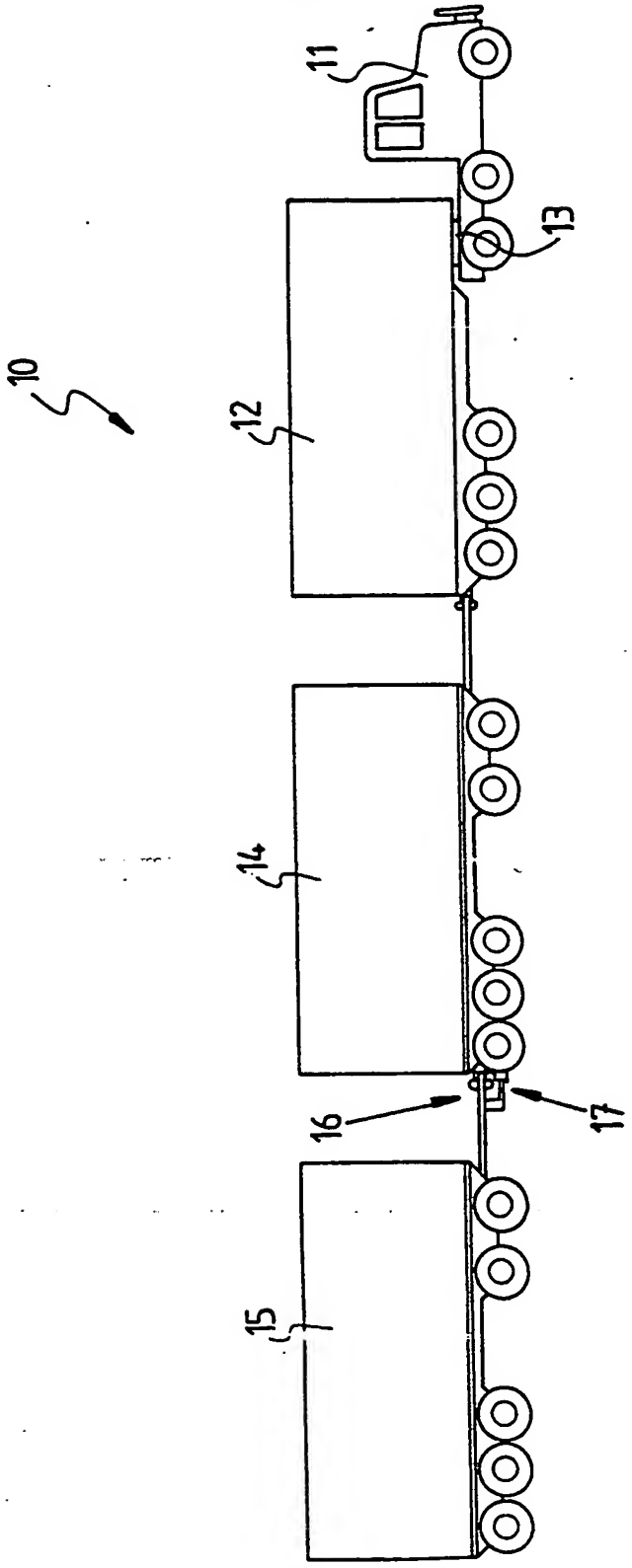

FIG. 1

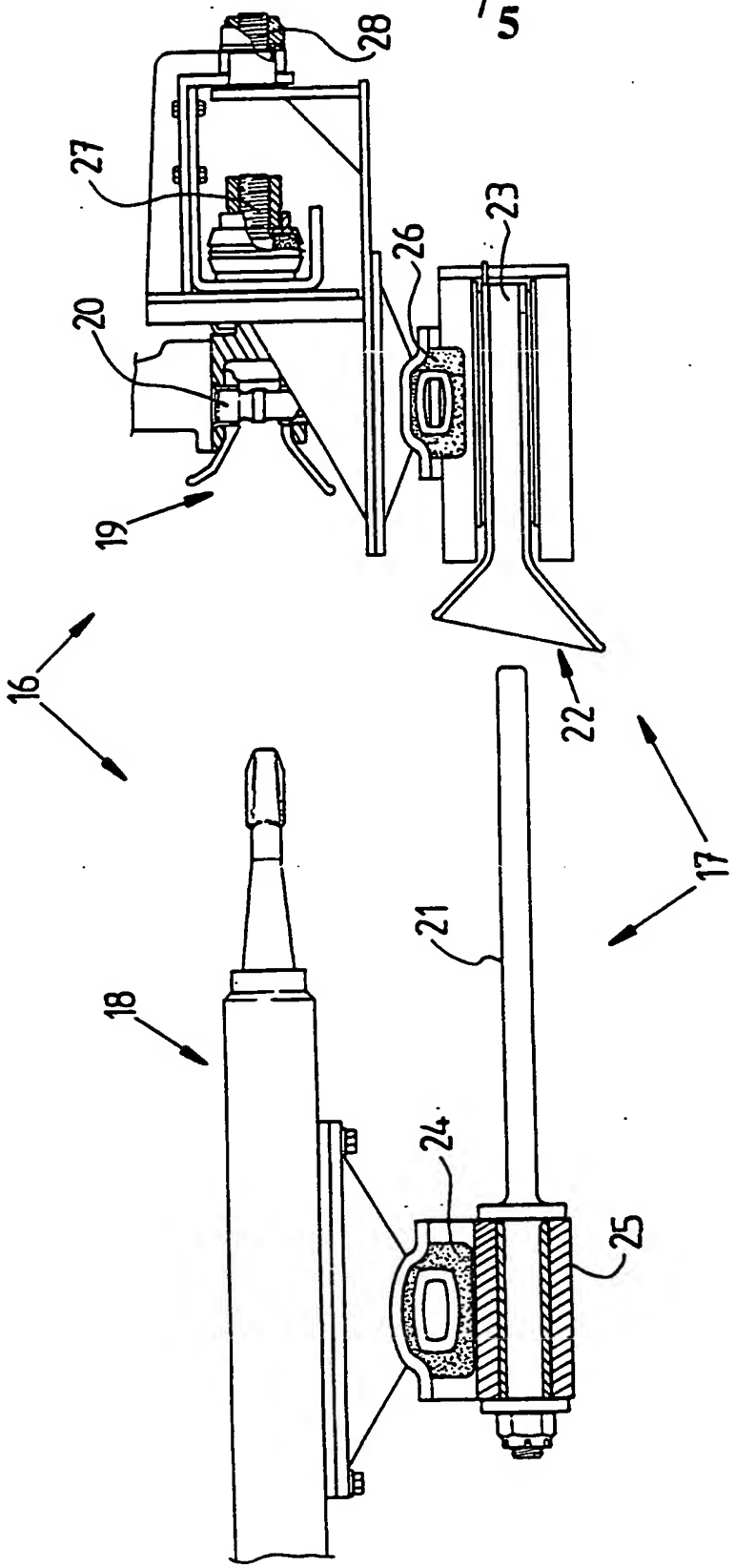

FIG. 2

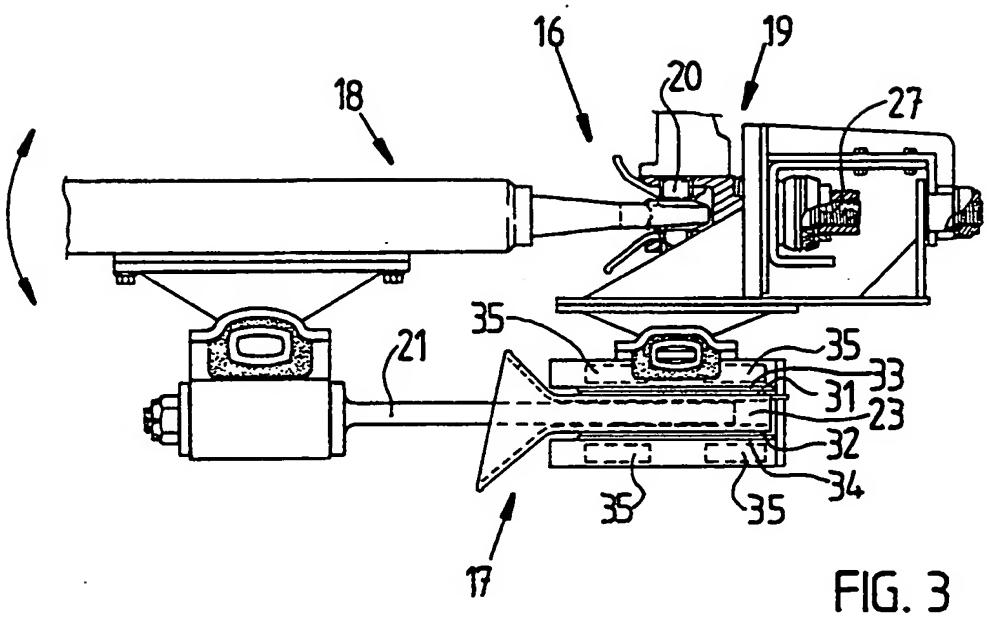
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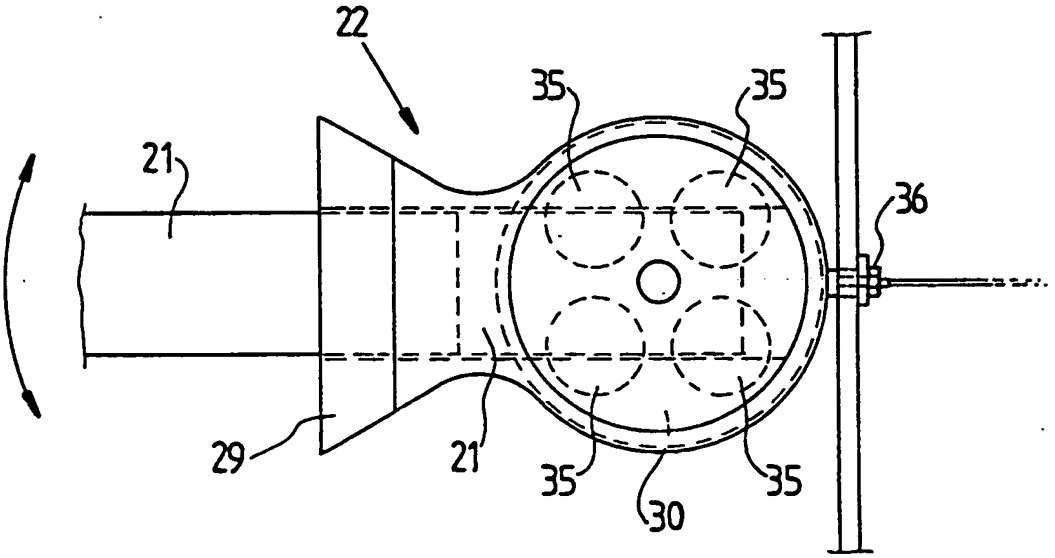
FIG. 3

FIG. 4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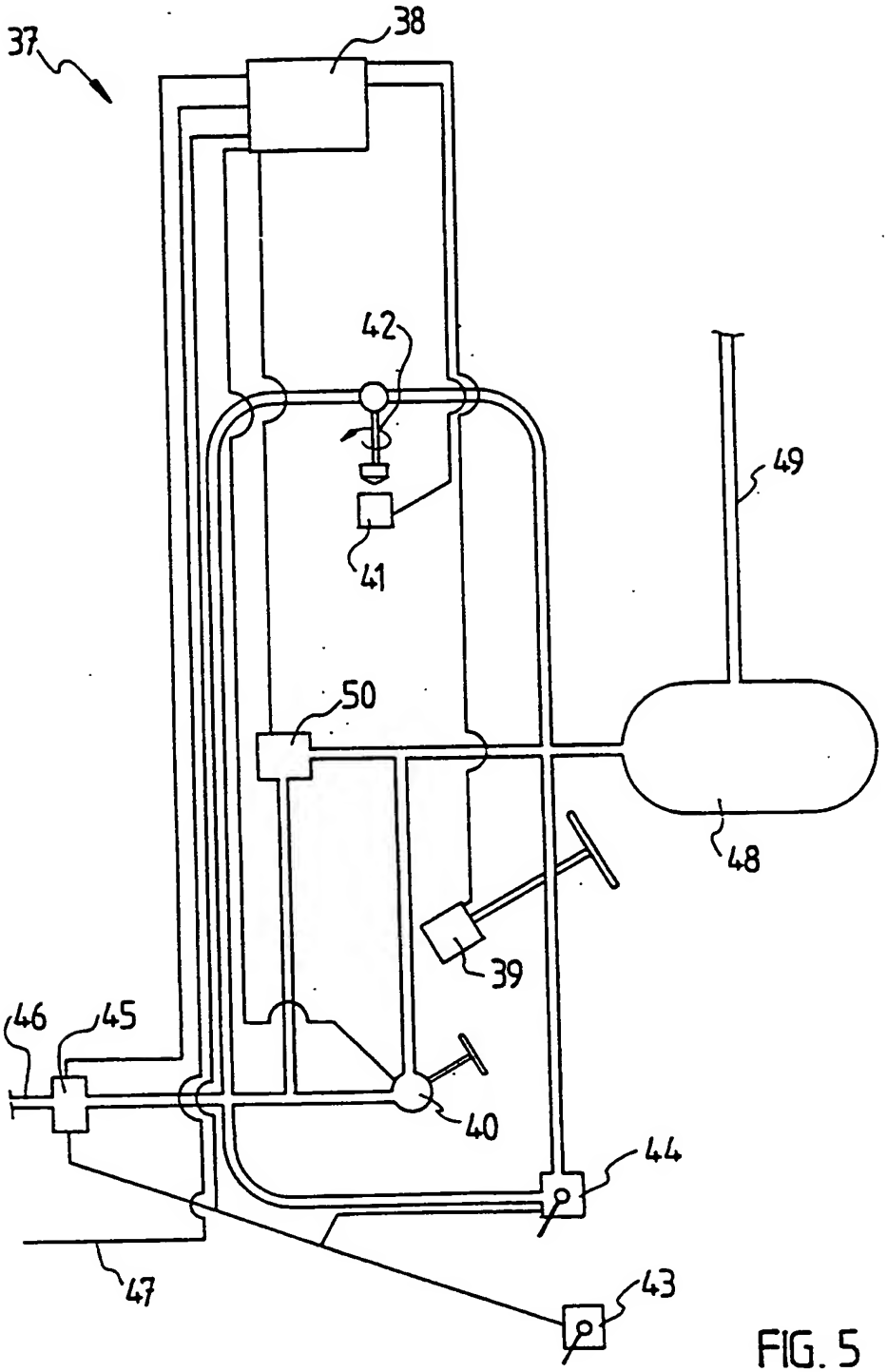

FIG. 5

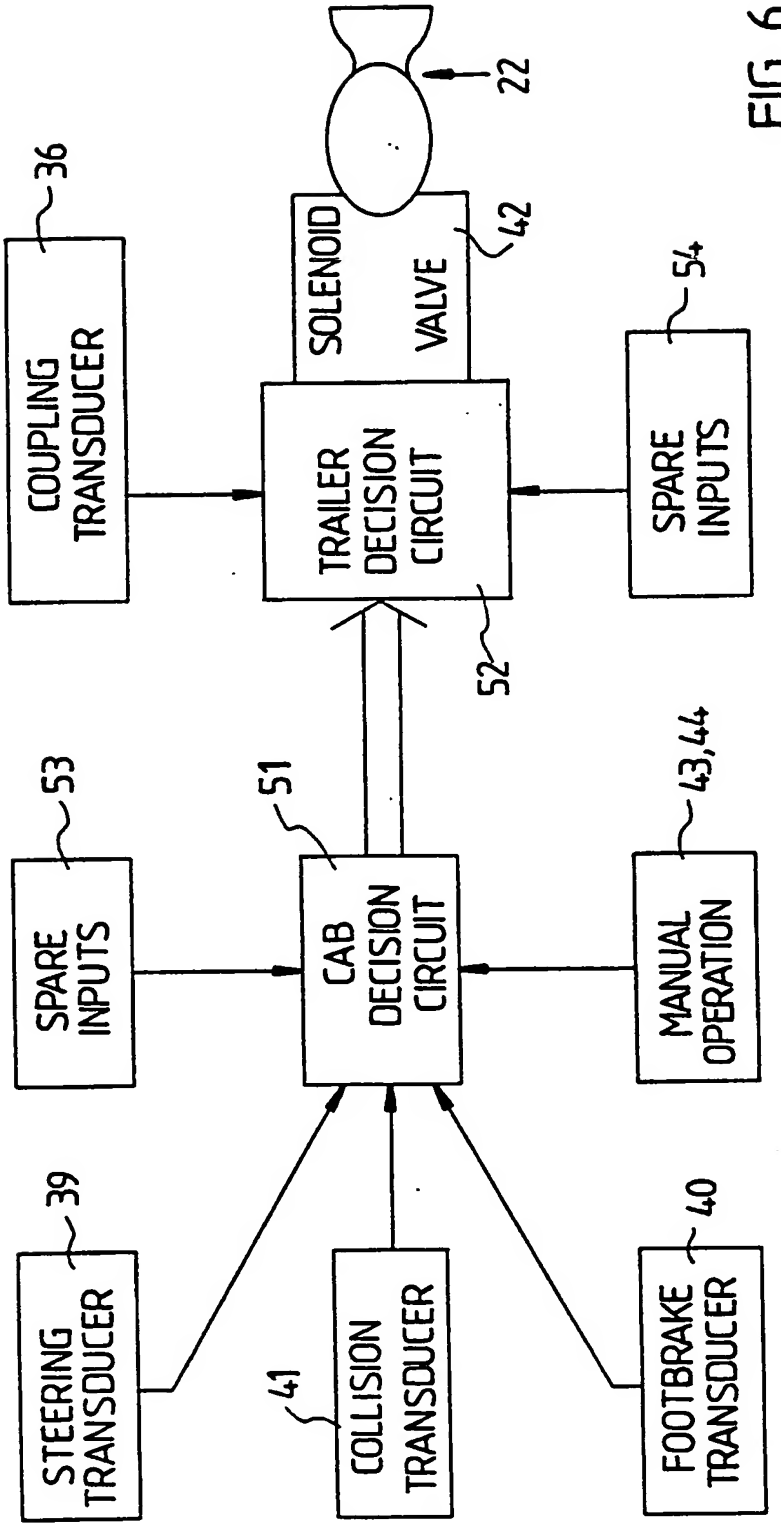
22
36
SOLENOID VALVE
42
54
COUPLING TRANSDUCER
TRAILER DECISION CIRCUIT
SPARE INPUTS
52
53
51
43,44
SPARE INPUTS
CAB DECISION CIRCUIT
MANUAL OPERATION
39
41
40
STEERING TRANSDUCER
COLLISION TRANSDUCER
FOOTBRAKE TRANSDUCER

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 93/00514

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.[5] B60D 1/30, B62D 53/08

According to International Patent Classification (IPC) or to both national classification and IPC

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	DE,A, 2949933 (WABCO FAHRZEUGBREMSEN GmbH) 19 June 1981 (19.06.81) page 5 third paragraph - page 6 last line	1,6,8
X	EP,A, 253964 (M.A.N. NUTZFAHRZEUGE GmbH) 27 January 1988 (27.01.88) Column 3 line 9 - Column 4 line 10	1,6,8
X	US,A, 4065148 (KOROKNAY et al) 27 December 1977 (27.12.77) Column 3 line 8 - Column 4 line 2	1,8
Y	Column 3 line 8 - Column 4 line 2	6

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
Y	EP,A, 358973 (ADAM OPEL AKTIENGESELLSCHAFT) 21 March 1990 (21.03.90) page 3 line 47 - page 6 line 9	6
X	US,A, 4556231 (SCHULTZ) 3 December 1985 (03.12.85) Column 3 line 56 - Column 5 line 50	1,8
X	BE,A, 898945 (DAIMLER-BENZ AKTIENGESELLSCHAFT) 18 June 1984 (18.06.84) page 6 line 8 - page 11 line 10	1,6,8
A	US,A, 3825282 (MEINHOLDT) 23 July 1974 (23.07.74) Column 4 line 17 - Column 5 line 6	
A	WO,A, 92/06883 (HAWKINS) 30 April 1992 (30.04.92) page 7 first paragraph	
A	EP,A, 381930 (MAURI & c.s.) 16 August 1990 (16.08.90) Column 2 line 24 - Column 3 line 21	
A	EP,A, 320202 (ENNIS) 14 June 1989 (14.06.89) Column 1 lines 20-51	
A	DT,A, 2513074 (ROHSIEPE) 7 October 1976 (07.10.76) Figure 1	

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DE	2949933	EP	30607				
EP	253964	DE	3623655	HU	57656		
US	4065148	GB	1527928				
US	4556231	DK HU	2172/83 34705	EP NO	122956 832097	FI DE	831706 3320278
WO	9206883	AU	89293/91	US	5232239		
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